VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

September 22, 2003

10 CFR 50.54(f)

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
11555 Rockville Pike
Rockville, Maryland 20852

Serial No. 03-459
NL&OS/GDM R2
Docket No. 50-280, 281
License No. DPR-32, 37

VIRGINIA ELECTRIC AND POWER COMPANY (DOMINION)
SURRY POWER STATION (SPS) UNITS 1 AND 2
THIRTY-DAY RESPONSE TO NRC BULLETIN 2003-02 (SPS UNIT 2)
NINETY-DAY RESPONSE TO NRC BULLETIN 2003-02 (SPS UNIT 1)
LEAKAGE FROM REACTOR PRESSURE VESSEL LOWER HEAD PENETRATIONS AND REACTOR COOLANT PRESSURE BOUNDARY INTEGRITY

On August 21, 2003 the NRC issued NRC Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin informs licensees that in light of the previous indications of cracking on the upper RPV head penetrations in the industry and the recent leakage indications on the two lower RPV head penetrations at South Texas Project Unit 1, the current methods of inspecting the RPV lower heads may need to be supplemented with additional measures (e.g., bare-metal visual inspections) to detect reactor coolant pressure boundary (RCPB) leakage. The bulletin requires licensees to provide a description of their reactor pressure vessel (RPV) lower head penetration inspection programs that they have previously implemented at their plants, as well as a description of the RPV lower head penetration inspection programs that they will be implementing during the next and subsequent refueling outages.

For licensees that will enter refueling outages before December 31, 2003, the bulletin requests a response be provided within 30 days of the date of the bulletin. As Surry Power Station Unit 2 currently has a scheduled Fall 2003 refueling outage, a 30-day response is provided in Attachment 1 providing the required information. For licensees with upcoming refueling outages scheduled after December 31, 2003, the bulletin requests a response within 90 days of the date of the bulletin. The 90-day response for Surry Unit 1 is also provided herein as Attachment 2.

If you have any questions or require additional information, please contact Mr. Gary D. Miller at (804) 273-2771.

Very truly yours,

David A. Christian
Senior Vice President – Nuclear Operations and
Chief Nuclear Officer

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Attachments

1. Thirty- Day Response to NRC Bulletin 2003-02, Surry Unit 2
2. Ninety-Day Response to NRC Bulletin 2003-02, Surry Unit 1

Commitments made in this letter:

1. A bare-metal visual examination of the 50 bottom-mounted instrumentation penetration nozzles will be performed during the Surry Unit 2 Fall 2003 refueling outage as described in Attachment 1.

2. A bare-metal visual examination of the 50 bottom-mounted instrumentation penetration nozzles will be performed during the Surry Unit 1 refueling outage currently scheduled for Fall 2004 as described in Attachment 2.

3. A bare-metal visual examination of the 50 bottom-mounted instrumentation penetration nozzles will be performed during subsequent refueling outages for Surry Units 1 and 2. This schedule may be adjusted in the future should ongoing research and inspection results justify a less frequent performance-based sample inspection schedule.

cc: U.S. Nuclear Regulatory Commission
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Surry Power Station

SN: 03-459
Docket Nos.: 50-280/281
Subject: 30 and 90-Day Response to
NRC Bulletin 2003-02

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by David A. Christian who is Senior Vice President and Chief Nuclear Officer of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 22nd day of September, 2003.

My Commission Expires: March 31, 2004.

Notary Public

(SEAL)

ATTACHMENT 1

Thirty- Day Response to NRC Bulletin 2003-02
Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Surry Power Station Unit 2

Virginia Electric and Power Company
(Dominion)

Thirty-Day Response to NRC Bulletin 2003-02
Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Surry Power Station Unit 2

On August 21, 2003 the NRC issued Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to inspections that have been or will be performed to verify the integrity of the reactor pressure vessel (RPV) lower head bottom-mounted instrumentation (BMI) penetration nozzles. A thirty-day response from the date of the bulletin is required for licensees with refueling outages scheduled prior to December 31, 2003. As Surry Power Station Unit 2 has a refueling outage scheduled for Fall 2003, a thirty-day response to the bulletin is required and is provided below.

Requested Information

(1) All subject PWR addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

(a) A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response

Previous RPV Lower Head BMI Penetration Nozzle Inspection Program

Prior to 2001, Surry Unit 2 performed visual (VT-2) examinations of the bottom of the reactor vessel during the system leakage test and during the system hydrostatic test. These examinations were performed every refueling outage and were conducted in accordance with ASME Code, Section XI, Category B-P, Item Nos. B15.10 and B15.11, which require a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations were conducted outside the RV lower head insulation. Since the containment building is maintained at subatmospheric conditions during the system leakage test and the system hydrostatic

test, the examiner was required to wear a self-contained breathing apparatus that limited his work duration and mobility. Consequently, on August 1, 2001, Code relief was granted by the NRC to perform the same VT-2 Code examinations when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). Therefore, the post-August 2001 VT-2 exam was also conducted outside the RV lower head insulation in accordance with the conditions specified in the NRC-approved relief request.

The results of the visual exam was documented in the applicable station procedure and forwarded to company records for maintenance after each refueling outage. No evidence of leakage was identified during the exam discussed above.

Regulatory Requirements

NRC Bulletin 2003-02 notes the following provisions in existing NRC regulations and plant operating licenses that pertain to the reactor coolant pressure boundary:

- Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants"

  Criteria 14 – "Reactor Coolant Pressure Boundary"

  Criteria 31 – "Fracture Prevention of Reactor Coolant Pressure Boundary", and

  Criteria 32 – "Inspection of Reactor Coolant Pressure Boundary"
- 10 CFR 50.55a, Codes and Standards, which incorporates by reference Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code"
- Appendix B of 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criteria V, IX, and XVI
- Plant Technical Specifications

The following discussion addresses each of these criteria.

Design Requirements: 10 CFR § 50, Appendix A – General Design Criteria

- Criterion 14 – Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."
- Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a

non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."

- Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

  "Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."

During the initial plant licensing of Surry Power Station Unit 2, it was demonstrated that the design of the reactor coolant pressure boundary met the regulatory requirements in place at that time. The GDC included in Appendix A to 10 CFR Part 50 did not become effective until May 21, 1971. The Construction Permits for Surry Units 1 and 2 were issued prior to May 21, 1971; consequently, these units were not subject to GDC requirements. (Reference SECY-92-223 dated September 18, 1992.) However, the following information demonstrates compliance with the design criteria relative to the RPV lower head BMI penetration nozzles:

- Pressurized water reactors licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or other austenitic materials with excellent corrosion resistance and extremely high fracture toughness, for reactor coolant pressure boundary materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts. NRC reviews of operating license submittals subsequent to issuance of Appendix A included evaluating designs for compliance with the General Design Criteria. Requirements in effect at the time of Surry's licensing did not address the selection of Alloy 600. They only required that ASME code requirements be satisfied.
- Although stress corrosion cracking of primary coolant system penetrations was not originally anticipated during plant design, it has occurred in the RPV top head nozzles at some plants. The root cause of the boric acid accumulation identified at South Texas Project Unit 1 at two BMI locations has yet to be determined. However, the robustness of the design has been demonstrated by the small amounts of leakage that have occurred on the upper RPV head penetration nozzles and by the fact that none of the cracks in Alloy 600 reactor coolant pressure boundary materials has rapidly propagated or resulted in catastrophic failure or gross rupture. Given the inherently high fracture toughness and flaw tolerance of the Alloy 600 material, there is in fact an extremely low probability of a rapidly propagating failure and gross rupture. It should be noted that earliest

versions of the applicable GDCs presented design criteria in functional terms of extremely low probability of gross rupture or significant leakage throughout design life.

- The ASME requirement for the inspection of BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. As noted above, Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). A 100% 360-degree bare-metal visual inspection was also performed on the 50 Surry Unit 1 lower head BMI penetration nozzles during the recent Spring refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

As described above, the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 respectively were satisfied as applicable during the plant's initial licensing review, and continue to be so satisfied during operation. Based on relevant inspections to date, there is no existing plant specific evidence that any of the lower head BMI penetration nozzles at Surry Unit 2 is cracked or leaking.

Operating Requirement: 10 C.F.R. § 50.36 - Plant Technical Specifications

- 10 CFR 50.36 (2) Limiting Conditions for Operation

  "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one of the following criteria:

  Criterion 3: A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

  Criterion 4: A structure, system or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

- 10 CFR 50.36 (3) Surveillance Requirements

  "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions will be met."

The reactor coolant pressure boundary is one of the three physical barriers to the release of radioactivity to the environment. Therefore, our plant Technical Specifications (TS) include a requirement and associated action statements addressing reactor coolant pressure boundary leakage. The limits for reactor coolant pressure boundary leakage at Surry Unit 2 are one (1) gallon per minute for unidentified leakage, ten (10) gpm for identified leakage, and no leakage from a non-isolable fault in the reactor coolant system pressure boundary.

The leakage observed at the two RPV lower head BMI penetration nozzles at South Texas Project Unit 1 were well below the sensitivity of on-line leakage detection systems. Even though the root cause of this leakage has yet to be determined, a 100% 360-degree bare-metal visual inspection of the lower head BMI penetration nozzles was conducted during the Surry Unit 1 refueling outage that was completed in June 2003. No indication of leakage was observed. Hypothetically, if a through-wall boundary leak of a BMI penetration nozzle increased to the point that the leakage was identified by an on-line leak detection monitor, then the leakage must be evaluated per the specified TS acceptance criteria, and the plant shut down if the leak exceeds TS limits, or it is determined that the leak is a non-isolable reactor coolant system pressure boundary fault. Plant TS requirements continue to be met.

Inspection Requirements: 10 C.F.R. § 50.55a and ASME Section XI

10 CFR Part 50.55a requires that inservice inspection and testing be performed per the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the reactor coolant pressure boundary.

As noted above, the ASME requirement for BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). The safety evaluation performed by the NRC that was included in Reference 1 concluded that "...the licensee's proposed alternative examination would provide reasonable assurance of leaktight integrity of the reactor vessel bottom head, including the instrumentation nozzle partial penetration welds."

Furthermore, a 100% 360-degree bare-metal visual inspection was performed for the Surry Unit 1 lower head BMI penetration nozzles during the Spring refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures" and IWB 3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels, and Examination Category B-P, All Pressure Retaining Components." Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Should repairs to RPV lower head BMI penetration nozzles be required, they will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

Surry Unit 2 complies with these ASME Code requirements through implementation of its inservice inspection program.

Quality Assurance Requirements: 10 C.F.R. § 50, Appendix B

- Criterion V of Appendix B to 10 CFR Part 50

  Criterion V of Appendix B to 10 CFR Part 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual examinations of RPV lower head BMI penetration nozzles will be documented in accordance with these requirements. Any work undertaken to inspect, evaluate, and/or repair the Surry Unit 2 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures which comply with the Company's Quality Assurance (QA) Topical Report, the QA program, and Criterion V of Appendix B to 10 CFR Part 50.

- Criterion IX of Appendix B to 10 CFR Part 50

  Criterion IX of Appendix B to 10 CFR Part 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

Personnel involved with the evaluation of the inspections will be VT-2 qualified in accordance with ASME Code requirements and will be familiar with the anticipated type of indication that leakage would cause. Any repair work that may be required in the event that evidence of leakage is identified at any of the Surry Unit 2 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures that will comply with ASME Code, regulatory and Company requirements.

- Criterion XVI of Appendix B to 10 CFR Part 50

  Criterion XVI of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions. For potential leakage identified at any RPV lower head BMI penetration nozzle, the root cause determination is important to understanding the nature of the degradation present and the required actions to mitigate future cracking. Appropriate corrective actions would be initiated to determine the root cause of the leakage and the proper repair technique to be used.

  Criterion XVI contains two important attributes pertinent to the potential for leakage at any RPV lower head BMI penetration nozzle.

  The first of these is "...that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected." This criterion infers a licensee's responsibility to be aware of industry experience, and has been interpreted in this manner in most plants' corrective action programs. A licensee should determine if industry experience applies to its plant and what, if any, corrective actions are appropriate. This approach is consistent with the NRC's generic communication process for an Information Notice, which reports industry experience, but does not require a response to the NRC. Licensees are expected to evaluate the applicability of the occurrence to their plant and document a record of the plant specific assessment for possible NRC review during inspections.

  Criterion XVI provides the objectives and goals of the corrective action program, but licensees are responsible for determining a specific process to accomplish these goals and objectives. With regard to the bulletin response, Criterion XVI does not provide specific guidance as to what is an appropriate response, but rather, the licensee is responsible for determining actions necessary to maintain public health and safety. Specifically, in this case, the licensee must justify its actions for addressing the potential of RPV lower head BMI penetration nozzle leakage. Furthermore, the regulatory criteria of 10 CFR 50.109(a)(7), provides supporting evidence when it states that "...if there are two or more ways to

achieve compliance . . . then ordinarily the applicant or licensee is free to choose the way which best suits its purposes."

The second attribute of Criterion XVI that should be considered is that for "... significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions." The bulletin suggests that for potential of RPV lower head BMI penetration nozzle leakage, the root cause determination is important in understanding the nature of the degradation and the required actions to mitigate future leaks. As part of its corrective action program, a licensee, through its own efforts or as part of an industry effort, would determine the cause of the leakage in an RPV lower head BMI penetration nozzle, if leakage were detected. However, if no known leakage in the BMI penetration nozzles was identified through reasonable quality assurance measures or inspection and monitoring programs, this criterion would not require specific action on the part of a licensee for remaining in compliance with the regulation.

In summary, the integrated industry approach to inspection, monitoring, cause determination, and resolution of potential leakage of an RPV lower head BMI penetration nozzle is clearly in compliance with the performance-based objectives of Appendix B. Furthermore, a 100% 360-degree bare-metal visual inspection was performed for the Surry Unit 1 lower head BMI penetration nozzles during the previous refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection. Therefore, we continue to believe that the appropriate regulatory requirements have been met to date.

(b) A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.

Response

The first attempt to perform a 100% 360-degree bare-metal VT-2 visual examination of the fifty (50) bottom mounted instrumentation (BMI) penetration nozzles underneath the Unit 2 RPV lower head insulation is scheduled for the upcoming Surry Unit 2 Fall 2003 refueling outage. This visual examination of the RPV lower head is considered an augmented examination. Engineering personnel performing this procedure will be

qualified as ASME visual level 2 (VT-2) examiners or greater and will perform the examination either directly or remotely. If direct examination is performed at the inspection location, then the characters on a visual test card/card standard must be seen within six feet. If remote examination equipment is used, then it must be demonstrated to resolve selected VT-2 test chart characters, as well as provide adequate color capability. It is intended to examine each BMI nozzle for the full 360-degree circumference. Inspection results will be recorded in an inspection report and maintained in company records. High-resolution video recording equipment and/or high-resolution digital still photographs may also be employed to further document the examination, as appropriate.

Dominion will document the as-found condition of suspect deposits whether adhering to the RPV lower head or present on the insulation facing the RPV. Any such deposit will be carefully evaluated to determine the most likely origin of the material based on visual, physical, and chemical evidence, as appropriate. Visual evidence will be evaluated with consideration of the guidance and examples given in industry reference materials for similar inspections of RPV upper heads supplemented by the recent observed conditions at the South Texas Project. Relevant physical evidence will be collected in a methodical manner that is intended to provide reliable, documented data for use in the evaluation process. Chemical and radioisotopic analysis techniques may be employed where appropriate to help discriminate between indications with operational implications versus indications from outage-related sources. Should evidence of boric acid deposits be identified on any of the BMI nozzles, the finding will be entered into the corrective action program for tracking, root cause determination and disposition/resolution of the condition. Appropriate notifications would be made consistent with regulatory requirements.

As noted in the response to Item 1(a) above, a 100% 360-degree bare-metal visual inspection was performed for the Surry Unit 1 lower head BMI penetration nozzles during the previous refueling outage completed in June 2003. The performance of this inspection required cutting access ports into the insulation in various locations. Consequently, we anticipate that we will be able to also perform a 100% 360-degree visual inspection of the Surry Unit 2 lower head BMI penetration nozzles as well. However, the presence of boric acid from other sources, or debris, could potentially mask BMI nozzle leakage indications should they exist. In addition, unanticipated interferences or difficulties with insulation removal/modification could inhibit inspection of certain penetration nozzles. Should this occur, any masking boric acid and/or debris will be cleaned off and, if necessary, appropriate modifications would be implemented to ensure that the affected nozzles that could not be adequately assessed during the upcoming outage would be accessible for inspection during the following refueling outage.

It is intended that the 100% 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles will be performed during each subsequent refueling outage. This schedule may be adjusted in the future should ongoing research and

inspection results determine that a less frequent (i.e., performance-based) inspection or sampling schedule is warranted.

Adherence to regulatory requirements was discussed in the response to Item 1(a) above. The performance of the 100% 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles during each future refueling outage as an augmented inspection in the inservice inspection program will further assure adherence to regulatory requirements.

(c) *If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).*

Response

A 100% 360-degree bare-metal visual examination of the 50 BMI penetration nozzles is planned during the Surry Unit 2 Fall 2003 refueling outage. If boric acid from other sources or debris is present, it could potentially mask leakage conditions at the nozzles should they exist. In that case, the masking boric acid and/or debris will be cleaned off the nozzles to allow a full assessment of the affected penetrations during the ongoing outage, if possible. In addition, unanticipated interferences or difficulties with insulation removal/modification could inhibit inspection of certain penetration nozzles. Should this occur, any masking boric acid and/or debris will be cleaned off, if necessary, and appropriate insulation modifications would be planned/implemented to ensure that the affected nozzles that could not be adequately assessed during the Fall 2003 refueling outage would be accessible for inspection during the next refueling outage (Spring 2005). Permanent modification of the lower head RPV insulation is also being considered to facilitate future inspection activities. It is Dominion's intention to ensure that following the upcoming inspection of the lower head RPV BMI penetration nozzles that the nozzles will be fully accessible for 100% 360-degree examinations during subsequent refueling outages.

(d) *If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.*

Response

A 100% 360-degree bare-metal visual examination of the 50 BMI penetration nozzles is currently planned for the Surry Unit 2 Fall 2003 refueling outage.

Reference

1. Letter from the USNRC to Mr. D. A. Christian dated August 1, 2001 (Serial No. 01-485), "Surry Power Station Units 1 and 2 Re: Inservice Inspection (ISI) Program Relief Requests RR 14 (Unit 1) and RR 8 (Unit 2) (TAC Nos. MB1083 and MB1084)."

ATTACHMENT 2

Ninety-Day Response to NRC Bulletin 2003-02 Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Surry Power Station Unit 1

Virginia Electric and Power Company
(Dominion)

Ninety-Day Response to NRC Bulletin 2003-02
Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity

Surry Power Station Unit 1

On August 21, 2003 the NRC issued Bulletin 2003-02, "Leakage from Reactor Pressure Vessel Lower Head Penetrations and Reactor Coolant Pressure Boundary Integrity." The bulletin requires licensees to provide information related to inspections that have been or will be performed to verify the integrity of the reactor pressure vessel (RPV) lower head penetrations. A ninety-day response from the date of the bulletin is required for licensees with refueling outages scheduled after December 31, 2003. As the next Surry Power Station Unit 1 refueling outage is scheduled for Fall 2004, a ninety-day response to the bulletin is required and is provided below.

Requested Information

(1) All subject PWR addressees are requested to provide the following information. The responses for facilities that will enter refueling outages before December 31, 2003, should be provided within 30 days of the date of this bulletin. All other responses should be provided within 90 days of the date of this bulletin.

(a) A description of the RPV lower head penetration inspection program that has been implemented at your plant. The description should include when the inspections were performed, the extent of the inspections with respect to the areas and penetrations inspected, inspection methods used, the process used to resolve the source of findings of any boric acid deposits, the quality of the documentation of the inspections (e.g., written report, video record, photographs), and the basis for concluding that your plant satisfies applicable regulatory requirements related to the integrity of the RPV lower head penetrations.

Response

Previous RPV Lower Head BMI Penetration Nozzle Inspection Program

Prior to 2001, Surry Unit 1 performed visual (VT-2) examinations of the bottom of the reactor vessel during the system leakage test and during the system hydrostatic test. These examinations were performed every refueling outage and were conducted in accordance with ASME Code, Section XI, Category B-P, Item Nos. B15.10 and B15.11, which require a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations were conducted outside the RV lower head insulation. Since the containment building is maintained at subatmospheric conditions during the system leakage test and the system hydrostatic test, the examiner was required to wear a self-contained breathing apparatus that

limited his work duration and mobility. Consequently, on August 1, 2001, Code relief was granted by the NRC to perform the same VT-2 Code examinations when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). Therefore, the post-August 2001 VT-2 exam was also conducted outside the RV lower head insulation in accordance with the conditions specified in the NRC-approved relief request.

The results of the visual exam are documented in the applicable station procedure and forwarded to company records for maintenance after each refueling outage. No evidence of leakage was identified during the exam discussed above.

Furthermore, a 100% 360-degree bare-metal visual inspection was performed for the 50 Surry Unit 1 RPV lower head BMI penetration nozzles during the Spring refueling outage completed in June 2003. Examiners who were VT-2 qualified as a minimum performed the nozzle inspections. The inspection of each penetration nozzle was performed for the full 360-degree circumference by either direct visual inspection or by the use of inspection mirrors. Access ports were cut into the lower head insulation to gain access to the nozzles for inspection and were subsequently repaired. Permanent modifications to the head insulation to facilitate future bare-metal inspections are currently being evaluated. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection. Digital photographs of the BMI penetration nozzle area were made to the extent possible for future reference.

Regulatory Requirements

NRC Bulletin 2003-02 notes the following provisions in existing NRC regulations and plant operating licenses that pertain to the reactor coolant pressure boundary:

- Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants"

  Criteria 14 – "Reactor Coolant Pressure Boundary"

  Criteria 31 – "Fracture Prevention of Reactor Coolant Pressure Boundary", and

  Criteria 32 – "Inspection of Reactor Coolant Pressure Boundary"
- 10 CFR 50.55a, Codes and Standards, which incorporates by reference Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components, of the ASME Boiler and Pressure Vessel Code"
- Appendix B of 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," Criteria V, IX, and XVI
- Plant Technical Specifications

The following discussion addresses each of these criteria.

Design Requirements: 10 CFR § 50, Appendix A – General Design Criteria

- Criterion 14 – Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed, fabricated, erected and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture."

- Criterion 31 – Fracture Prevention of Reactor Coolant Pressure Boundary

  "The reactor coolant pressure boundary shall be designed with sufficient margin to assure that when stressed under operating, maintenance, testing, and postulated accident conditions (1) the boundary behaves in a non-brittle manner, and (2) the probability of rapidly propagating fracture is minimized. The design shall reflect consideration of service temperatures and other conditions of the boundary material under operating, maintenance, testing and postulated accident conditions and the uncertainties in determining (1) material properties, (2) the effects of irradiation on material properties, (3) residual, steady state and transient thermal stresses, and (4) size of flaws."

- Criterion 32 – Inspection of Reactor Coolant Pressure Boundary

  "Components which are part of the reactor coolant pressure boundary shall be designed to permit (1) periodic inspection and testing of important areas and features to assess their structural and leak tight integrity, and (2) an appropriate material surveillance program for the reactor pressure vessel."

During the initial plant licensing of Surry Power Station Unit 1, it was demonstrated that the design of the reactor coolant pressure boundary met the regulatory requirements in place at that time. The GDC included in Appendix A to 10 CFR Part 50 did not become effective until May 21, 1971. The Construction Permits for Surry Units 1 and 2 were issued prior to May 21, 1971; consequently, these units were not subject to GDC requirements. (Reference SECY-92-223 dated September 18, 1992.) However, the following information demonstrates compliance with the design criteria relative to the RPV lower head BMI penetration nozzles:

- Pressurized water reactors licensed both before and after issuance of Appendix A to 10 CFR Part 50 (1971) complied with these criteria in part by: 1) selecting Alloy 600 or other austenitic materials with excellent corrosion resistance and extremely high fracture toughness, for reactor coolant pressure boundary materials, and 2) following ASME Codes and Standards and other applicable requirements for fabrication, erection, and testing of the pressure boundary parts. NRC reviews of operating license submittals subsequent to issuance of Appendix A included evaluating designs for compliance with the General Design Criteria. Requirements in effect at the time of Surry's licensing did not address the selection of Alloy 600. They only required that ASME code requirements be satisfied.

- Although stress corrosion cracking of primary coolant system penetrations was not originally anticipated during plant design, it has occurred in the RPV top head nozzles at some plants. The root cause of the boric acid accumulation identified at South Texas Project Unit 1 at two BMI locations has yet to be determined. However, the robustness of the design has been demonstrated by the small amounts of the leakage that have occurred on the RPV upper head penetration nozzles and by the fact that none of the cracks in Alloy 600 reactor coolant pressure boundary materials has rapidly propagated or resulted in catastrophic failure or gross rupture. Given the inherently high fracture toughness and flaw tolerance of the Alloy 600 material, there is in fact an extremely low probability of a rapidly propagating failure and gross rupture. It should be noted that earliest versions of the applicable GDCs presented design criteria in functional terms of extremely low probability of gross rupture or significant leakage throughout design life.
- The ASME requirement for the inspection of BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. As noted above, Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). A 100% 360-degree bare-metal visual inspection was also performed on the Surry Unit 1 lower head BMI penetration nozzles during the Spring refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection. These inspections will be performed during subsequent refueling outages as well.

As described above, the requirements established for design, fracture toughness, and inspectability in GDC 14, 31, and 32 respectively were satisfied as applicable during the plant's initial licensing review, and continue to be so satisfied during operation. Based on relevant inspections to date, there is no existing plant specific evidence that any of the lower head BMI penetration nozzles at Surry Unit 1 is cracked or leaking.

Operating Requirement: 10 C.F.R. § 50.36 - Plant Technical Specifications

- 10 CFR 50.36 (2) Limiting Conditions for Operation

  "Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met. A technical specification limiting condition for operation of a nuclear reactor must be established for each item meeting one of the following criteria:

Criterion 3: A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.

Criterion 4: A structure, system or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety."

- 10 CFR 50.36 (3) Surveillance Requirements

  "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions will be met."

The reactor coolant pressure boundary is one of the three physical barriers to the release of radioactivity to the environment. Therefore, our plant Technical Specifications (TS) include a requirement and associated action statements addressing reactor coolant pressure boundary leakage. The limits for reactor coolant pressure boundary leakage at Surry Unit 1 are one (1) gallon per minute for unidentified leakage, ten (10) gpm for identified leakage, and no leakage from a non-isolable fault in the reactor coolant system pressure boundary.

The leakage observed at the two RPV lower head BMI penetration nozzles at South Texas Project Unit 1 were well below the sensitivity of on-line leakage detection systems. Even though the root cause of this leakage has yet to be determined, a 100% 360-degree bare-metal visual inspection of the lower head BMI penetration nozzles was conducted during the Surry Unit 1 refueling outage that was completed in June 2003. No indication of leakage was observed. Hypothetically, if a through-wall boundary leak of a BMI penetration nozzle increased to the point that the leakage was identified by an on-line leak detection monitor, then the leakage must be evaluated per the specified TS acceptance criteria, and the plant shut down if the leak exceeds TS limits, or it is determined that the leak is a non-isolable reactor coolant system pressure boundary fault. Plant TS requirements continue to be met.

Inspection Requirements: 10 C.F.R. § 50.55a and ASME Section XI

10 CFR Part 50.55a requires that inservice inspection and testing be performed per the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, "Inservice Inspection of Nuclear Plant Components." Section XI contains applicable rules for examination, evaluation and repair of code class components, including the reactor coolant pressure boundary.

As noted above, the ASME requirement for BMI penetration nozzles is for a visual (VT-2) examination of the bottom of the reactor vessel during the system leakage

test of IWB-5221 and during the system hydrostatic test of IWB-5222. Consistent with ASME Code requirements, these examinations are conducted outside the RPV lower head insulation. Code relief was granted by the NRC to perform the same VT-2 Code examination when the reactor containment is at atmospheric conditions, and the reactor vessel is at ambient temperature and pressure (Reference 1). The safety evaluation performed by the NRC that was included in Reference 1 concluded that "...the licensee's proposed alternative examination would provide reasonable assurance of leaktight integrity of the reactor vessel bottom head, including the instrumentation nozzle partial penetration welds."

Furthermore, a 100% 360-degree bare-metal visual inspection was performed for the Surry Unit 1 RPV lower head BMI penetration nozzles during the Spring refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection.

The acceptance standard for the visual examination is found in paragraphs IWA-5250, "Corrective Measures" and IWB 3522, "Standards for Examination Category B-E, Pressure Retaining Partial Penetration Welds in Vessels, and Examination Category B-P, All Pressure Retaining Components." Paragraph IWA-5250 requires repair or replacement of the affected part if a through-wall leak is found and requires an assessment of damage, if any, associated with corrosion of steel components by boric acid. Should repairs to RPV lower head BMI penetration nozzles be required, they will be performed in accordance with Section XI requirements, NRC-approved ASME Code Case requirements, or an alternative repair or replacement method approved by the NRC.

Surry Unit 1 complies with these ASME Code requirements through implementation of its inservice inspection program.

<u>Quality Assurance Requirements: 10 C.F.R. § 50, Appendix B</u>

- Criterion V of Appendix B to 10 CFR Part 50

  Criterion V of Appendix B to 10 CFR Part 50 states that activities affecting quality shall be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings. Criterion V further states that instructions, procedures, or drawings shall include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished. Visual examinations of RPV lower head BMI penetration nozzles will be documented in accordance with these requirements. Any of the work undertaken to inspect, evaluate, and/or repair the Surry Unit 1 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures which comply with the Company's Quality Assurance (QA) Topical Report, the QA program, and Criterion V of Appendix B to 10 CFR Part 50.

- Criterion IX of Appendix B to 10 CFR Part 50

  Criterion IX of Appendix B to 10 CFR Part 50 states that special processes, including nondestructive testing, shall be controlled and accomplished by qualified personnel using qualified procedures in accordance with applicable codes, standards, specifications, criteria, and other special requirements.

  Personnel involved with the evaluation of the inspections will be VT-2 qualified in accordance with ASME Code requirements and will be familiar with the anticipated type of indication that leakage would cause. Any repair work that may be required in the event that evidence of leakage is identified at any of the Surry Unit 1 RPV lower head BMI penetration nozzles will be conducted and documented in accordance with existing or new procedures that will comply with ASME Code, regulatory and Company requirements.

- Criterion XVI of Appendix B to 10 CFR Part 50

  Criterion XVI of Appendix B to 10 CFR Part 50 states that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected. For significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions. For potential leakage identified at any RPV lower head BMI penetration nozzle, the root cause determination is important to understanding the nature of the degradation present and the required actions to mitigate future cracking. Appropriate corrective actions would be initiated to determine the root cause of the leakage and the proper repair technique to be used.

  Criterion XVI contains two important attributes pertinent to the potential for leakage at any RPV lower head BMI penetration nozzle.

  The first of these is "...that measures shall be established to assure that conditions adverse to quality are promptly identified and corrected." This criterion infers a licensee's responsibility to be aware of industry experience, and has been interpreted in this manner in most plants' corrective action programs. A licensee should determine if industry experience applies to its plant and what, if any, corrective actions are appropriate. This approach is consistent with the NRC's generic communication process for an Information Notice, which reports industry experience, but does not require a response to the NRC. Licensees are expected to evaluate the applicability of the occurrence to their plant and document a record of the plant specific assessment for possible NRC review during inspections.

  Criterion XVI provides the objectives and goals of the corrective action program, but licensees are responsible for determining a specific process to accomplish

these goals and objectives. With regard to the bulletin response, Criterion XVI does not provide specific guidance as to what is an appropriate response, but rather, the licensee is responsible for determining actions necessary to maintain public health and safety. Specifically, in this case, the licensee must justify its actions for addressing the potential of RPV lower head BMI penetration nozzle leakage. Furthermore, the regulatory criteria of 10 CFR 50.109(a)(7), provides supporting evidence when it states that "...if there are two or more ways to achieve compliance . . . then ordinarily the applicant or licensee is free to choose the way which best suits its purposes."

The second attribute of Criterion XVI that should be considered is that for "... significant conditions adverse to quality, the measures taken shall include root cause determination and corrective action to preclude repetition of the adverse conditions." The bulletin suggests that for potential of RPV lower head BMI penetration nozzle leakage, the root cause determination is important in understanding the nature of the degradation and the required actions to mitigate future leaks. As part of its corrective action program, a licensee, through its own efforts or as part of an industry effort, would determine the cause of the leakage in an RPV lower head BMI penetration nozzle, if leakage were detected. However, if no known leakage in the BMI penetration nozzles was identified through reasonable quality assurance measures or inspection and monitoring programs, this criterion would not require specific action on the part of a licensee for remaining in compliance with the regulation.

In summary, the integrated industry approach to inspection, monitoring, cause determination, and resolution of potential leakage of an RPV lower head BMI penetration nozzle is clearly in compliance with the performance-based objectives of Appendix B. Furthermore, a 100% 360-degree bare-metal visual inspection was performed for the Surry Unit 1 lower head BMI penetration nozzles during the previous refueling outage completed in June 2003. No evidence of boric acid leakage at any BMI penetration nozzle was identified during this inspection. Therefore, we continue to believe that the appropriate regulatory requirements have been met to date.

(b) *A description of the RPV lower head penetration inspection program that will be implemented at your plant during the next and subsequent refueling outages. The description should include the extent of the inspections which will be conducted with respect to the areas and penetrations to be inspected, inspection methods to be used, qualification standards for the inspection methods, the process used to resolve the source of findings of boric acid deposits or corrosion, the inspection documentation to be generated, and the basis for concluding that your plant will satisfy applicable regulatory requirements related to the structural and leakage integrity of the RPV lower head penetrations.*

Response

A 100% 360-degree bare-metal VT-2 visual examination of the fifty (50) bottom-mounted instrumentation (BMI) penetration nozzles underneath the Unit 1 RPV lower head insulation will be performed during the next Surry Unit 1 refueling outage currently scheduled for Fall 2004. This visual examination of the RPV lower head is considered an augmented examination. Engineering personnel performing this procedure will be qualified as ASME visual level 2 (VT-2) examiners or greater and will perform the examination either directly or remotely. If direct examination is performed at the inspection location, then the characters on a visual test card/card standard must be seen within six feet. If remote examination equipment is used, then it must be demonstrated to resolve selected VT-2 test chart characters, as well as provide adequate color capability. Each BMI nozzle will be examined for the full 360-degree circumference. Inspection results will be recorded in an inspection report and maintained in station records. High-resolution video recording equipment and/or high-resolution digital still photographs may also be employed to further document the examination, as appropriate.

Dominion will document the as-found condition of suspect deposits whether adhering to the RPV lower head or present on the insulation facing the RPV. Any such deposit will be carefully evaluated to determine the most likely origin of the material based on visual, physical, and chemical evidence, as appropriate. Visual evidence will be evaluated with consideration of the guidance and examples given in industry reference materials for similar inspections of RPV upper heads supplemented by the recent observed conditions at the South Texas Project. Relevant physical evidence will be collected in a methodical manner that is intended to provide reliable, documented data for use in the evaluation process. Chemical and radioisotopic analysis techniques may be employed where appropriate to help discriminate between indications with operational implications versus indications from outage-related sources. Should evidence of boric acid deposits be identified on any of the BMI nozzles, the finding will be entered into the corrective action program for tracking, root cause determination and disposition/resolution of the condition. Appropriate notifications would be made consistent with regulatory requirements.

It is intended that the 100% 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles will be performed during each subsequent refueling outage. This schedule may be adjusted in the future should ongoing research and inspection results determine that a less frequent (i.e., performance-based) inspection or sampling schedule is warranted.

Adherence to regulatory requirements was discussed in the response to Item 1(a) above. The performance of the 100% 360-degree bare-metal visual examination of the RPV lower head BMI penetration nozzles during each subsequent refueling outage as an augmented inspection in the inservice inspection program will further assure adherence to regulatory requirements.

(c) If you are unable to perform a bare-metal visual inspection of each penetration during the next refueling outage because of the inability to perform the necessary planning, engineering, procurement of materials, and implementation, are you planning to perform bare-metal visual inspections during subsequent refueling outages? If so, provide a description of the actions that are planned to enable a bare-metal visual inspection of each penetration during subsequent refueling outages. Also, provide a description of any penetration inspections you plan to perform during the next refueling outage. The description should address the applicable items in paragraph (b).

Response

A 100% 360-degree bare-metal visual examination of the 50 BMI penetration nozzles is planned during the next Surry Unit 1 refueling outage currently scheduled for Fall 2004. As noted in Dominion's response to Item 1(a) above, a 100% 360-degree bare-metal inspection of the lower head BMI penetration nozzles was previously performed during the Spring 2003 refueling outage. Although not expected based on previous inspection results, if boric acid from other sources or debris is present, it could potentially mask leakage conditions at the nozzles should they exist. In that case, the masking boric acid and/or debris will be cleaned off the nozzles to allow a full assessment of the affected penetrations during the ongoing outage, if possible. In addition, permanent modification of the lower head RPV insulation is being considered to facilitate easier access to the BMI penetration nozzles during future inspection activities.

(d) If you do not plan to perform either a bare-metal visual inspection or non-visual (e.g., volumetric or surface) examination of the RPV lower head penetrations at the next or subsequent refueling outages, provide the basis for concluding that the inspections performed will assure applicable regulatory requirements are and will continue to be met.

Response

As noted above, a 100% 360-degree bare-metal visual examination of the 50 BMI penetration nozzles has already been performed for Surry Unit 1. The next such inspection is planned for the Surry Unit 1 refueling outage currently scheduled for Fall 2004.

Reference

1. Letter from the USNRC to Mr. D. A. Christian dated August 1, 2001 (Serial No. 01-485), "Surry Power Station Units 1 and 2 Re: Inservice Inspection (ISI) Program Relief Requests RR 14 (Unit 1) and RR 8 (Unit 2) (TAC Nos. MB1083 and MB1084)."